

New Records of Bahamian Odonata

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THE dragonfly fauna of the Bahama Islands remained virtually undocumented until Westfall (1960) listed the Bahamian odonate specimens in the collection of the American Museum of Natural History. Vaurie (1952) and Rabb and Hayden (1957) had previously discussed the collecting of some of these specimens in their general accounts.

I was fortunate in being able to collect dragonflies in the Bahamas during three visits there. These trips allowed me to sample the faunas of South Bimini (17-19 November 1962), Cat Island (27 November-2 December 1963), and San Salvador (26 December 1963-2 January 1964). In addition, I received collections made by Dr. Fred G. Thompson on Andros (30 October-1 November 1963) and by Cecil R. Warren on South and East Bimini (16-22 August 1964). My wife, Mary Lynn, collected a single specimen on Grand Bahama Island (11 April 1963). Dr. Minter J. Westfall, Jr., called my attention to a Bahamian specimen of interest in the University of Florida Collections and allowed me to borrow specimens in his care. Dr. Oliver Flint permitted me to examine pertinent specimens of *Anax longipes* in the United States National Museum, and Dr. Thomas W. Donnelly furnished a specimen and additional information of the same species. The following list includes all specimens obtained in the above-mentioned collections.

Lestes scalaris Gundlach. CAT ISLAND, 1 mi. S Tea Bay, 29 November (2); SAN SALVADOR, 6.6 mi. S Cockburn Town, 1 January (3). A mating pair and a single male were observed at a small pond surrounded by buttonwoods on Cat Island, all two to three feet above the water. The species was common at the San Salvador locality, and several mating pairs were seen. They perched low in the dense stand of *Phragmites* occupying most of the shallower parts of the pond. None was observed in the coppice, where *L. spumarius* was often encountered.

The appendages of the four males collected agree in detail with those figured by Calvert (1909: Pl. I, Figs. 17, 18). They have been compared with specimens from Cuba, Jamaica, and Puerto Rico, and agree in all respects, with the exception of one aspect of the wing venation, which apparently varies geographically. A

postnodal index was devised by totalling the postnodals of all four wings for each specimen. Bahamian specimens have fewer postnodals (31-40 in five specimens) than do those from Jamaica (40-48 in seven specimens). A Cuban individual agrees best with those from the Bahamas (29 postnodals), and one from Puerto Rico is intermediate (39 postnodals).

L. scalaris has been recorded from Cuba, Puerto Rico (Calvert, 1909), and Hispaniola (Needham, 1941). The present records add Jamaica (by the courtesy of M. J. Westfall, Jr.) and the Bahamas to the known range, which is thus the entire Greater Antilles and Bahamas. It is completely sympatric with the following species.

Lestes spumarius Selys. SOUTH BIMINI, 16-22 August (1); CAT ISLAND, hills above The Bight, 28 November (1); Orange Creek, 1 December (1); SAN SALVADOR, 3.6 mi. S Cockburn Town, 1 January (3). At the last locality, several mating pairs were seen in low weeds around a small pond that was completely surrounded by coppice. Other adults were observed in grass at a pond 6.6 mi. S Cockburn Town; when disturbed, they flew immediately into the adjacent low coppice. Only three were found on Cat Island, although many hours were spent in their favored habitat. The species was rather common in the coppice on South Bimini in both August and November. On all three islands where I observed *spumarius*, individuals were seen in the densest forest present, in which they hung vertically from small twigs five to seven feet above the ground. When flushed, they flew only a short distance (ten to thirty feet) but were so well camouflaged that I usually lost sight of them until I disturbed them again.

As in *L. scalaris*, individuals from the Bahamas and Cuba have fewer postnodals than do those from elsewhere in the Greater Antilles. A Cuban specimen has 39, thirteen Bahamian specimens have 40-47, eleven Jamaican specimens have 45-56, and two Hispaniolan specimens have 45-48 postnodals. In this species a correlated variation in size is evident. The hind wings of ten Bahamian males vary from 19-21 mm, those of two males from Hispaniola and six males from Jamaica from 22-23 mm. No such variation was noted in *scalaris*, in which the range of the hind wing length is 17-19 mm. Larvae and exuviae of *Lestes* were collected on Andros, Cat Island, and San Salvador, but I have been unable thus far to determine their specific identity.

Argiallagma minutum Selys. CAT ISLAND, 1 mi. S Tea Bay, 29

November (1); SAN SALVADOR, 3 mi. S Cockburn Town, 26 December (1); 3.6 mi. S. Cockburn Town, 1 January (2). This species was common at ponds on both islands. Larvae, exuviae, and teneral were numerous at shallow marshes with abundant sedge (*Eleocharis spp.*) growth near Tea Bay. Another larva was collected from a pond 5 mi. NW Fresh Creek, Andros.

Ischnura ramburi Selys. ANDROS, Andros Town, 31 October (12); 2.5 mi. SE Andros Town, 31 October (1); CAT ISLAND, 1 mi. S Tea Bay, 29 November (4); SAN SALVADOR, 1 mi. NE Cockburn Town, 28 December (1); 6.6 mi. S Cockburn Town, 1 January (1). *I. ramburi* was locally common on Cat Island and uncommon on San Salvador. Only one was seen on South Bimini in November 1962. Large series of larvae were collected on Andros and in a fresh-water pond south of Tea Bay on Cat Island.

Westfall (1960) reported both "typical *ramburi* with the dorsum of segment 9 entirely black, and also the subspecies *credula* Hagen" from the Bahamas. I have re-examined most of the specimens listed by Westfall and categorized them and the ones listed above. Individuals with more than half of the dorsum of segment nine black were called "*ramburi*," those with more than half of that segment blue were called "*credula*," and those with about half black and half blue were called "intermediate." Both males and homochromatic females were included. On South Bimini, Andros, and New Providence, *ramburi* is the predominant form (10 of 12 specimens). On Stanyard Cay, San Salvador, Crooked Island, Great Inagua, and South Caicos, *credula* is the predominant form (11 of 13 specimens). Mixed populations are present on Eleuthera (5 *ramburi*, 3 intermediate, 1 *credula*) and Cat Island (3 *ramburi*, 2 intermediate, 8 *credula*). Thus a geographic correlation is clearly evident, the northern Bahamas inhabited by the *ramburi*-type and the southern islands by the *credula*-type, with intermediate populations on the intervening islands.

Credula is the dominant or exclusive form elsewhere in the West Indies (Calvert, 1901-1908; Klots, 1932; Whitehouse, 1943) and *ramburi* the dominant form in Florida (Byers, 1930; and my examination of over 800 specimens from south Florida), and the two may be distributed more-or-less in the pattern of allopatric subspecies in these areas. However, Calvert (1901-1908) reported much mixing of the two types, and I have taken both throughout southern Mexico and examined *credula* from as far north as Sinaloa

and *ramburi* from as far south as Colima on the Pacific coast and Guatemala on the Caribbean coast. Considering the extremely broad area of overlap of the two forms and the common occurrence of both chromotypes in far-flung populations, no biogeographic purpose is served by the formal recognition of *credula* as a subspecies, and I consider it a strict synonym of *ramburi*.

Anomalagrion hastatum Say. SAN SALVADOR, 6.6 mi. S Cockburn Town, 30 December (1). No others were seen on any of the islands, surprising in light of the abundance and wide distribution of the species from Westfall's (1960) records.

Anax junius Drury. ANDROS, Andros Town, 31 October (1); CAT ISLAND, 1 mi. S Tea Bay, 29 November (1). A few were seen on South Bimini at a fresh-water rockpit. Last instar larvae were very common in another rockpit on the same island and were found emerging not long after dark on 18 November. Adults were scattered over Cat Island, breeding in the ponds near Tea Bay. Two females oviposited (unattended by males) at one pond, and a very young *Anax* larva was collected there. A half-grown *junius* larva was taken in a pond 2 mi. SE Andros Town, Andros.

Anax longipes concolor Brauer. SAN SALVADOR, 1 mi. N Cockburn Town, 26 December (1); 6.6 mi. S Cockburn Town, 1 January (1). A half-grown larva of this species was collected from a small pond at Knowles, Cat Island. Several males flew over a small pond south of Cockburn Town, and four or five individuals cruised over the scrub at Watling's Castle, the highest hill in the area. When first seen in the field, these dragonflies were a source of puzzlement to me, as they looked like no *Anax* known from the northern hemisphere. When in the hand, it could be seen that they were structurally much like *A. longipes* from Florida, but smaller and differently colored. Notes on the coloration of the male in life were taken: frons and thorax lime green, abdominal segments 1 and 2 same color, 2 porcelain blue distally; 3 to 10 blackish with pale green spots (small transverse ones on anterior third and larger rhombic ones on posterior third of middle segments); appendages brown; femora reddish, remainder of legs black. The female was quite similar, although lacking the blue on the second segment. Both are fully hardened adults.

Brauer described *Anax concolor* from Brazil in 1865, and Hagen (1890) and Martin (1908) considered it a race of *A. longipes*. During the same period, Kirby (1890) and Muttkowski (1910) listed it

as a full species in their catalogues, the latter mistakenly reporting it from throughout the known range of *longipes*. The same authors were divided on their ideas of the range of *longipes*, Kirby recording it from only the United States and the other three listing it as well from Haiti and Mexico, Muttkowski from Jamaica, and Martin from Brazil. Calvert (1901-1908) did not discuss *concolor* but recorded *longipes* from the United States, Mexico, Brazil, and Haiti. He then (1909) added the Bahamas to the known range of the species from a specimen taken on Eleuthera. Thus no real consistency is evident in the treatment of these forms at the turn of the century. Since that time, no mention of the relationship of *longipes* and *concolor* has appeared in the literature, and nothing has been said of the biology of *concolor*.

My specimens from San Salvador agreed with the diagnosis of the Brazilian *concolor* rather than the northern *longipes*, prompting an analysis of the distribution and relationship of the two forms. The following specimens were examined: Arkansas, 3; Tennessee, 1; North Carolina, 5; South Carolina, 6; Georgia, 6; Florida, 11; San Salvador, 2; Dominica, 4; Mexico, 1; Costa Rica, 1; Bolivia, 5; and Brazil, 2.

Hind wing lengths of these specimens in millimeters are as follows: United States, 49-51; San Salvador, 46-48; Dominica, 46.5-49; Mexico, 45; Costa Rica, 46; Bolivia, 45-46; and Brazil, 40-44. Measurements of the hind femora and tibiae of United States specimens (respectively 13.5-15 mm and 12-13 mm) do not overlap those of tropical specimens (respectively 10-13 mm and 9-11 mm). The abdominal coloration is difficult to assess in many of the dried specimens. All United States individuals, insofar as can be determined, have reddish abdomens. The male abdomens are unpatterned, those of the females obscurely marked with paler spots. Teneral females (two reared from North Carolina) are spotted exactly as described above for the San Salvador male, except the spots are blue on segments 3 to 8 and yellowish to greenish on nine. I have seen no teneral males, but the very conspicuous spotting of the teneral females in *longipes*, later replaced by red-brown overall, indicates *concolor* as the ancestral form. Some specimens from outside the United States appear to have reddish abdomens, but this may be an artifact of drying. The abdomens of two males which I collected (San Salvador and Veracruz, Mexico) were brightly marked in life but faded to brown after drying. Probably all

tropical populations of the species have dark brown or black abdomens with bluish or greenish spots.

Although published records are valueless at the subspecies level (all West Indian and Mexican records, for example, having been listed merely as *longipes*), I consider the two forms allopatric representatives of one another, the relationship best expressed by the use of trinomials. Provisionally, *A. l. longipes* is restricted to the United States, occurring along the Atlantic and Gulf coastal plains from Massachusetts (Hagen, 1890) to eastern Texas (T. W. Donnelly, *in litt.*). At least a few individuals have been found west of the Appalachians in Ohio (Borror, 1937; Borror and Epstein, 1942) and Indiana (Montgomery, 1949). *A. l. concolor* probably occurs throughout the West Indies and from Mexico (Veracruz and Guerrero) through Central America to Brazil. Thus the two races are separated by a salt-water gap between the Bahamas and Florida and a desert gap between central Texas and northeastern Mexico, both of which are important biogeographic barriers for terrestrial organisms. Either gap might be crossed with ease by a strong-flying species like *longipes*, but breeding success should be poor to nonexistent in the intervening areas. Even assuming the sporadic incursion of individuals of one race into the territory inhabited by the other, interbreeding may be prevented by the visual dissimilarity of the races. If indeed odonates choose their mates visually, at least in groups which bear bright, species-specific patterns, then *longipes* and *concolor* are as effectively isolated reproductively as any two species of *Anax*. I am at present retaining them as subspecies because of their structural identity and obvious very close relationship.

Gynacantha ereagris Gundlach. ANDROS, Andros Town, 31 October (2). Westfall (1960) overlooked a Bahamian record of this species (Calvert, 1919), a male collected on Crooked Island on 24 November 1890 by the University of Pennsylvania Expedition. On Cat Island *ereagris* was fairly common in low scrub adjacent to a marshy area east of the coastal coppice at Orange Creek. One was shot after observing it at close range, but a large snake (*Alsophis*), which darted out from the spot where it fell, diverted my attention long enough for the dragonfly to flutter away. On San Salvador, a few brown aeshnids were seen which were probably this species. From those observed on Cat Island, my impression is that this species frequents more open areas than does *G. nervosa*.

Only two were observed in the dense coppice, whereas many were seen in the open scrub nearby.

Gynacantha nervosa Rambur. SOUTH BIMINI, 18 November (1). Five or six were seen in the coppice in as many hours of field work there. As none was found on the other islands by me or previous collectors, it may be that *nervosa* has reached the Biminis from southern Florida, where it is very common.

Triacanthagyna trifida Rambur. SAN SALVADOR, 7.1 mi. N Cockburn Town, 27 December (1). This species swarmed at dusk in small numbers at two localities on San Salvador.

Orthemis ferruginea Fabricius. SOUTH BIMINI, 16-22 August (1); ANDROS, 2.5 mi. SE Andros Town, 31 October (4); CAT ISLAND, 1 mi. S Tea Bay, 29 November (2); SAN SALVADOR, 6.6 mi. S Cockburn Town, 1 January (1). Both sexes were observed in numbers on all islands visited, being exceeded in general abundance only by *Erythrodiplax umbrata*.

Libellula needhami Westfall. NEW PROVIDENCE, July-August 1961 (1). Dr. Westfall has asked me to include this specimen, a male collected by Martin Dickinson, in the present paper. It furnishes the first Bahamian record for *needhami*.

Macrodiplax balteata Hagen. CAT ISLAND, 1 mi. S Tea Bay, 30 November (1). Males were seen at a number of open *Chara*-filled fresh-water ponds on Cat Island, and a pair in tandem flew over one of the ponds for some time. A last instar larva was collected at Andros Town, Andros.

Idiataphe longipes cubensis Scudder. ANDROS, 5 mi. NW Fresh Creek, 1 November (1).

Brachymesia furcata Hagen. CAT ISLAND, 1 mi. S Tea Bay, 29 November (2). This species was fairly common at ponds on Cat Island, and one male was observed at a pond on San Salvador.

Pachydiplax longipennis Burmeister. ANDROS, Andros Town, 31 October (1); 2.5 mi. SE Andros Town, 31 October (2).

Micrathyria didyma Selys. CAT ISLAND, 1 mi. S Tea Bay, 29 November (1); Tea Bay, 1 December (1); SAN SALVADOR, 6.6 mi. S Cockburn Town, 1 January (1). A few of each sex were seen at small ponds and in the coppice near Tea Bay. Exuviae were collected there and at Knowles on stems of *Typha* within a foot of the water. A few adults perched on *Phragmites* at the pond on San Salvador.

Erythrodiplax berenice naeva Hagen. SOUTH BIMINI, 16-22 Au-

gust (23); EAST BIMINI, 21 August (4); ANDROS, 2.5 mi. SE Andros Town, 31 October (1). Westfall (1960) recorded *E. b. berenice* Drury from the Bimini Islands and *E. b. naeva* from elsewhere in the Bahamas, following determinations made by Dr. Donald J. Borror. My Bimini material is rather intermediate between the two races. The small stigma and relatively open venation ally it with *naeva*, as does the lack of pigment in the wings of all females. The penes are not the much angulated structures of *naeva*, but they diverge from Floridian *berenice* in the direction of *naeva*. The single Andros male is identical in venation and stigma size to the Bimini males, but its penis is more typical of *naeva*, although still not as extreme as those of Greater Antillean males or even many from the Florida Keys. In general, I believe that all Bahamian specimens of the species should be referred to *naeva*, even though the structure of the penis varies as much as it does. Bimini specimens are quite distinct from *E. b. berenice* as typified by specimens from North Carolina, Florida, Mississippi, and Texas.

Erythrodiplax connata Burmeister. ANDROS, 2.5 mi. SE Andros Town, 31 October (1). This female is apparently the same as specimens from Andros and New Providence associated with *E. connata* by Borror (in Westfall, 1960).

Erythrodiplax justiniana Selys. ANDROS, 2.5 mi. S Andros Town, 30 October (1).

Erythrodiplax umbrata Linnaeus. SOUTH BIMINI, 16-22 August (14); ANDROS, Andros Town, 31 October (1); 2.5 mi. SE Andros Town, 31 October (3); 2.7 mi. SE Andros Town, 31 October (8); 2 mi. NW Fresh Creek, 1 November (1); SAN SALVADOR, 6.6 mi. S Cockburn Town, 1 January (1). Males were seen in numbers in late November at an area where leakage from a water pipe produced marshy conditions on South Bimini. They were also common around a few ponds on Cat Island and one on San Salvador. Females were widespread in scrub and coppice on South Bimini and Cat Island, greatly outnumbering males. The series from Andros, collected at random around several ponds, included more young than mature individuals. Larvae were collected at the same ponds, and exuviae were found within a few inches of the water in a sinkhole pond on Cat Island.

Lepthemis simplicicollis Say. CAT ISLAND, 1 mi. S Tea Bay, 29 November (1). This species was fairly common at a few localities on Cat Island but was not observed on San Salvador, where it was

apparently common in March 1953 (Westfall, 1960). Two exuviae and a few small larvae were taken on Cat Island.

Lepthemis vesiculosa Fabricius. This species is uncommon in the Bahamas; the Van Voast-American Museum of Natural History Expedition collected none, and I saw no adults on my fall and winter visits at a season when *vesiculosa* is common in south Florida. However, an exuvia and last instar larvae were collected from small ponds at two localities on Cat Island.

Tramea abdominalis Rambur. CAT ISLAND, Tea Bay, 30 November (1); Orange Creek, 1 December (1); SAN SALVADOR, 6.6 mi. S. Cockburn Town, 1 January (1). Only scattered individuals of this and the following species were seen.

Tramea binotata Rambur. GRAND BAHAMA ISLAND, Freeport, 11 April (1); ANDROS, 2.5 mi. SE Andros Town, 31 October (3); 1.5 mi. S. Andros Town, 1 November (1); CAT ISLAND, 1 mi. S Tea Bay, 30 November (2); SAN SALVADOR, 7.1 mi. N Cockburn Town, 28 December (1). This species was slightly more common than *T. abdominalis* on the islands visited. Among small numbers of trameas with narrow wing spots observed on South Bimini, several were approached closely enough to associate them definitely with this species.

Tramea lacerata Hagen. One female of this species seen on South Bimini in late November was easily identified by its overall black color, large wing patches, and conspicuous yellow abdominal spots. These occupy most of segment seven of the abdomen and are an excellent field recognition character for *T. lacerata*.

Tramea onusta Hagen. SOUTH BIMINI, 16-22 August (3); CAT ISLAND, The Bight, 28 November (2); Knowles, 1 December (3); SAN SALVADOR, 6.6 mi. S Cockburn Town, 1 January (1). A few *onusta* were seen on South Bimini and San Salvador, and on Cat Island it was everywhere the common species. Males and mated pairs were present at all the fresh-water ponds, the pairs ovipositing in typical *Tramea* fashion. Immature individuals swarmed over the road from one end of the island to the other, and larvae of all sizes and exuviae were common at most ponds. Three larvae were reared.

Pantala flavescens Fabricius. SOUTH BIMINI, 16-22 August (1); 19 November (1); ANDROS, 2.5 mi. S Andros Town, 30 October (2); SAN SALVADOR, 3.3 mi. S Cockburn Town, 1 January (1). A few adults were seen on South Bimini, and full-grown larvae were com-

mon in a small fresh-water rockpit along with those of *Anax junius*. An exuvia was found on a grass stem at an almost dry pond in pineland on New Providence, 26 November 1963, and a few adults were seen at the same place. Two larvae were collected at 5 mi. NW Fresh Creek on Andros. A few adults were seen on Cat Island and more on San Salvador, where one was collected in late afternoon hanging from a twig at the edge of a path through the copice. It moved up the path ahead of me in a manner reminiscent of a *Gynacantha*.

DISCUSSION

Westfall (1960) listed 26 species of Odonata from the Bahama Islands, two of which (*Epiaeschna heros*, *Pachydiplax longipennis*) were without specific locality data. *Gynacantha ereagris*, listed by Calvert (1919) from the islands, brought the list to 27. The present paper cites a definite locality for *Pachydiplax* and adds six species to the known fauna (*Lestes scalaris*, *Gynacantha nervosa*, *Libellula needhami*, *Macrodiplax balteata*, *Leptemis vesiculosa*, and *Tamea lacerata*), bringing the total to 33. Of this list, at least six species (*Coryphaeschna ingens*, *Epiaeschna heros*, *Gynacantha nervosa*, *Celithemis eponina*, *Libellula needhami*, and *Tamea lacerata*) may be only vagrants from the nearby Florida peninsula, but the others are probably breeding residents. All previous records of Bahamian dragonflies referred only to the adults, but the present paper records the collection of larvae of at least twelve species.

As presently known, the Bahamian odonate fauna indicates affinities with both the Greater Antilles and the southeastern United States. Records of *Coryphaeschna ingens*, *Epiaeschna heros*, *Celithemis eponina*, and *Tamea lacerata* indicate mainland affinities, but these isolated records of stragglers are of little zoogeographical importance. *Pachydiplax longipennis* remains the only species which faunistically ties the Bahamas to Florida rather than the Antilles. From the south the Bahamas have received populations of *Lestes scalaris*, *L. spumarius*, *Argiallagma minutum*, *Anax longipes concolor*, *Gynacantha ereagris*, *Micrathyria didyma*, *Erythrodiplax connata* cf. *connata*, *E. justiniana*, and *Dythemis rufinervis*, none of which occur in Florida, as well as eleven tropical species which have reached Florida as well. Of special interest is the presence in south Florida of Antillean species which have

not colonized the Bahamas so far as is known. These include *Lestes tenuatus*, *Enallagma cardenium*, *Neoerythromma cultellatum*, *Coryphaeschna viriditas*, *Miathyria marcella*, and *Tauriphila australis*. *Anax amazili* and *Brachymesia herbida*, both wanderers to south Florida, do not breed there and cannot be considered important in this connection. The stream-dwelling habits of *E. cardenium* may have precluded its establishment in the Bahamas, as would the breeding habits of *Miathyria* and *Tauriphila* (Paulson, 1966), but *L. tenuatus*, *N. cultellatum*, and *C. viriditas* should find satisfactory breeding sites in the Bahamas. The fortuitousness of colonization may be the most important factor in the differences between the tropical odonate faunas of south Florida and the Bahamas.

The seasonal aspects of Neotropical dragonfly faunas have received little attention in the literature. This has been because collections were made on short visits of nonresident collectors who could not draw a picture of seasonal changes. Calvert attempted to correlate the seasonal distribution of a few forms with the rainy season (1908, 1931; Calvert and Calvert, 1917), but he unfortunately never published the seasonal data he accumulated for many species in his year in Costa Rica. The writer (1966) found that as high as 29 per cent of the anisopteran and 42 per cent of the zygopteran fauna of southern Florida were found as adults throughout, or at least during, mid-winter. As on the Tropical mainland and elsewhere in the West Indies, the Bahamian fauna is too poorly known seasonally to allow the conclusions possible to workers in better documented areas. However, available records indicate that a very high proportion of Bahamian species fly throughout the year. All of the widespread and common residents (*Lestes spumarius*, *Argiallagma minutum*, *Ischnura ramburi*, *Anomalagrion hastatum*, *Orthemis ferruginea*, *Idiataphe longipes*, *Brachymesia furcata*, *Erythrodiplax berenice*, *E. umbrata*, *Tramea abdominalis*, *T. binotata*, *T. onusta*, and *Pantala flavescens*) have been taken in the winter months (December to February). Dragonfly collecting in the Bahamas has been concentrated in the winter (October to April), and mid-summer records are scattered. Enough of the latter are available for the less common species, most of which have been taken in the winter, to indicate an all-year season for them as well. Mid-winter occurrence has been reported for *Anax longipes*, *Brachymesia furcata*, and *Erythrodiplax*

berenice, species usually absent at that season in southern Florida. The southern Bahamas, south of the Florida peninsula, are the source of some of these records. On both Cat Island and San Salvador I was impressed by the abundance of Odonata relative to their numbers in the Florida Keys at the same season. The Keys are climatically much like the Bahamas and could support adult Odonata in numbers throughout the year, yet an extreme mid-winter reduction in individuals if not species in the former area has been brought about by some extrinsic factor(s) apparently not present in the Bahamas. These tropical species might be expected to be relatively intolerant of temperate conditions, yet it is noteworthy that *they* are the long-season species in southern Florida, rather than the temperate species which have moved into that area from the north. Although poorly documented, it appears that some of the Bahamian species have flight seasons like those which they occupy in southern Florida. Thus the gynacanthines fly during the fall and *Pantala hymenaea* in mid-summer.

A final word on the subject of Bahamian Odonata concerns further problems in the area. A thorough knowledge of the fauna of the major islands, especially Grand Bahama, Andros, and Great Inagua, will be necessary to elucidate the present zoogeographic status of the area. The relative proximity of Andros to Florida and its extensive fresh-water marshes make it a likely target for invasion by Floridian species, especially those of the Everglades. *Coryphaeschna ingens*, *Libellula needhami*, *Celithemis eponina*, and *Brachymesia gravida*, for instance, should find their ecological requirements adequately satisfied on that island as *Pachydiplax* apparently has. At least ten species of Bahamian birds, mostly restricted to the northern islands, show direct affinities with Florida forms rather than Antillean forms (Bond, 1956), and a similar phenomenon may yet be discovered in the Odonata. In addition, the Bahamas from a practical standpoint represent a very accessible area to study life histories and habits of tropical dragonflies, amply justifying repeated visits by the serious investigator.

LITERATURE CITED

- BOND, JAMES. 1956. Check-list of birds of the West Indies. Acad. Nat. Sci. Phila., Philadelphia, ix + 214 pp.
- BORROR, DONALD J. 1937. An annotated list of the dragonflies (Odonata) of Ohio. Ohio Jour. Sci., vol. 37, pp. 185-196.

- BORROR, DONALD J., AND ERWIN J. EPSTEIN. 1942. New records of Ohio dragonflies (Odonata). *Ohio Jour. Sci.*, vol. 42, pp. 81-83.
- BYERS, C. FRANCIS. 1930. A contribution to the knowledge of Florida Odonata. *Univ. Fla. Publ., Biol. Sci. Series*, vol. 1, pp. 1-327.
- CALVERT, AMELIA S., AND PHILIP P. CALVERT. 1917. A year of Costa Rican natural history. The MacMillan Co., New York, xix + 577 pp.
- CALVERT, PHILIP P. 1901-1908. *Biologia Centrali-Americana*. Vol. 50: Neuroptera. Porter & Dulau, London, xxx + 420 pp., 10 pls.
- . 1908. The composition and ecological relations of the odonate fauna of Mexico and Central America. *Proc. Acad. Nat. Sci. Phila.*, 1908, pp. 460-491, pl. 26.
- . 1909. Contributions to a knowledge of the Odonata of the Neotropical region exclusive of Mexico and Central America. *Ann. Carnegie Mus.*, vol. 6, pp. 73-281.
- . 1919. Gundlach's work on the Odonata of Cuba. *Trans. Amer. Ent. Soc.*, vol. 45, pp. 335-396.
- . 1931. The generic characters and the species of *Palaemnema* (Odonata: Agrionidae). *Trans. Amer. Ent. Soc.*, vol. 57, pp. 1-111, pls. 1-21.
- HAGEN, HERMANN A. 1890. Synopsis of the Odonata of North America, No. 2. The genus *Anax*. *Psyche*, vol. 5, pp. 303-308.
- KIRBY, W. F. 1890. A synonymic catalogue of Neuroptera Odonata, or dragonflies. Gurney & Jackson, London, ix + 202 pp.
- KLOTS, ELSIE B. 1932. Insects of Porto Rico and the Virgin Islands. Odonata or dragon flies. *Sci. Surv. Porto Rico and Virgin I.*, vol. 14, pp. 1-107, pls. 1-7.
- MARTIN, RENÉ. 1908-1909. *Coll. Zool. du Baron Edm. de Selys Longchamps. Cat. System. et Descrip. Fasc. 18-20, Aeschnines*. Bruxelles, 223 pp., 6 pls.
- MONTGOMERY, B. ELWOOD. 1949. *Anax longipes* Hagen (Odonata: Aeshnidae), an Atlantic Coastal species in Indiana. *Proc. Indiana Acad. Sci.*, vol. 58, p. 151.
- MUTTKOWSKI, RICHARD A. 1910. Catalogue of the Odonata of North America. *Bull. Publ. Mus. Milwaukee*, vol. 1, pp. 1-207.
- NEEDHAM, JAMES G. 1941. Life history notes on some West Indian coenagrionine dragonflies (Odonata). *Jour. Agric. Univ. Puerto Rico*, vol. 25, pp. 1-19.
- PAULSON, DENNIS R. 1966. The dragonflies (Odonata: Anisoptera) of southern Florida. Unpubl. doctoral dissertation, University of Miami, 603 pp.

- RABB, GEORGE B., AND ELLIS B. HAYDEN, JR. 1957. The Van Voast-American Museum of Natural History Bahama Islands Expedition. Record of the expedition and general features of the islands. Amer. Mus. Novitates, no. 1836, pp. 1-53.
- VAURIE, PATRICIA. 1952. Insect collecting in the Bimini Island group, Bahama Islands. Amer. Mus. Novitates, no. 1565, pp. 1-24.
- WESTFALL, MINTER J., JR. 1960. The Odonata of the Bahama Islands, the West Indies. Amer. Mus. Novitates, no. 2020, pp. 1-12.
- WHITEHOUSE, FRANCIS C. 1943. A guide to the study of dragonflies of Jamaica. Bull. Inst. of Jamaica, Sci. Series, no. 3, pp. 1-69.

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